Progress Report

DEVELOPMENT OF A Ti:Al_2O_3 LASER FOR REMOTE SENSING OF THE ATMOSPHERE

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Dr. Hani Elsayed-Ali
Associate Professor
Department of Electrical and Computer Engineering
Old Dominion University
Norfolk, VA 23529-0246

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to

Dr. Russell J. Deyoung
Mail Stop 401A
Atmospheric Sciences Division
NASA Langley Research Center
Hampton, VA 23681-0001

PROGRESS REPORT

The development of a titanium sapphire laser system would be a substantial improvement in mass, volume, and efficiency over present YAG pumped dye lasers for remote sensing of O_3 and water vapor in the atmosphere. More advanced laser systems than presently available are needed to measure stratospheric ozone. Such a system would be used in the differential absorption lidar (DIAL) remote-sensing program at NASA Langley Research Center. The DIAL concept uses two laser beams: one beam turned to the peak of an O_3 absorption line and the other tuned away of any O_3 absorption. By analyzing the scattered light return signal as a function of time, the density of the species at a specific distance can be achieved. The present NASA DIAL laser does not have enough energy per pulse to measure stratospheric ozone. Because of the ease in tunability and the solid-state reliability of titanium doped sapphire lasers in addition to the large energy storage in the gain media, such a system would represent a significant improvement over dye lasers.

At the Atmospheric Sciences Division a program was initiated two years ago to develop a breadboard $Ti:Al_2O_3$ laser system which would demonstrate 200 mj per pulse at 285 nm and 100 mj per pulse at 315 nm with 300-μs pulse separation. Several approaches were evaluated. Flashlamp pumping of the $Ti:Al_2O_3$ seems to offer the best compromise between reliability and cost and test-stand facility is under construction. This system is a low-repetition-rate system with the primary intention to develop the expertise needed for the construction of an aircraft based laser system. An important development in this program was the recent construction of Ti:Sapphire

laser cavity, which presently operate with broad band output at (2.7 nm) centered around 866 nm. The following tasks were performed:

1. Construction of the Ti: Sapphire laser and obtaining broadband lasing at 866 nm.
2. Three intercavity prisms were installed to produce narrow linewidth operation.
3. Work is in progress to obtain "on" and "off" line for the DIAL laser system using the Ti:Sapphire laser.

A schematic diagram of the laser system is shown in Fig. 1. Broadband lasing is demonstrated in Fig. 2. The progress achieved so far is according to schedule.

All experimental research under this grant was accomplished at NASA Langley Research Center by Mr. Wen Situ, a Ph.D. graduate student at Old Dominion University.

Ti:Sapphire Laser System Schematic

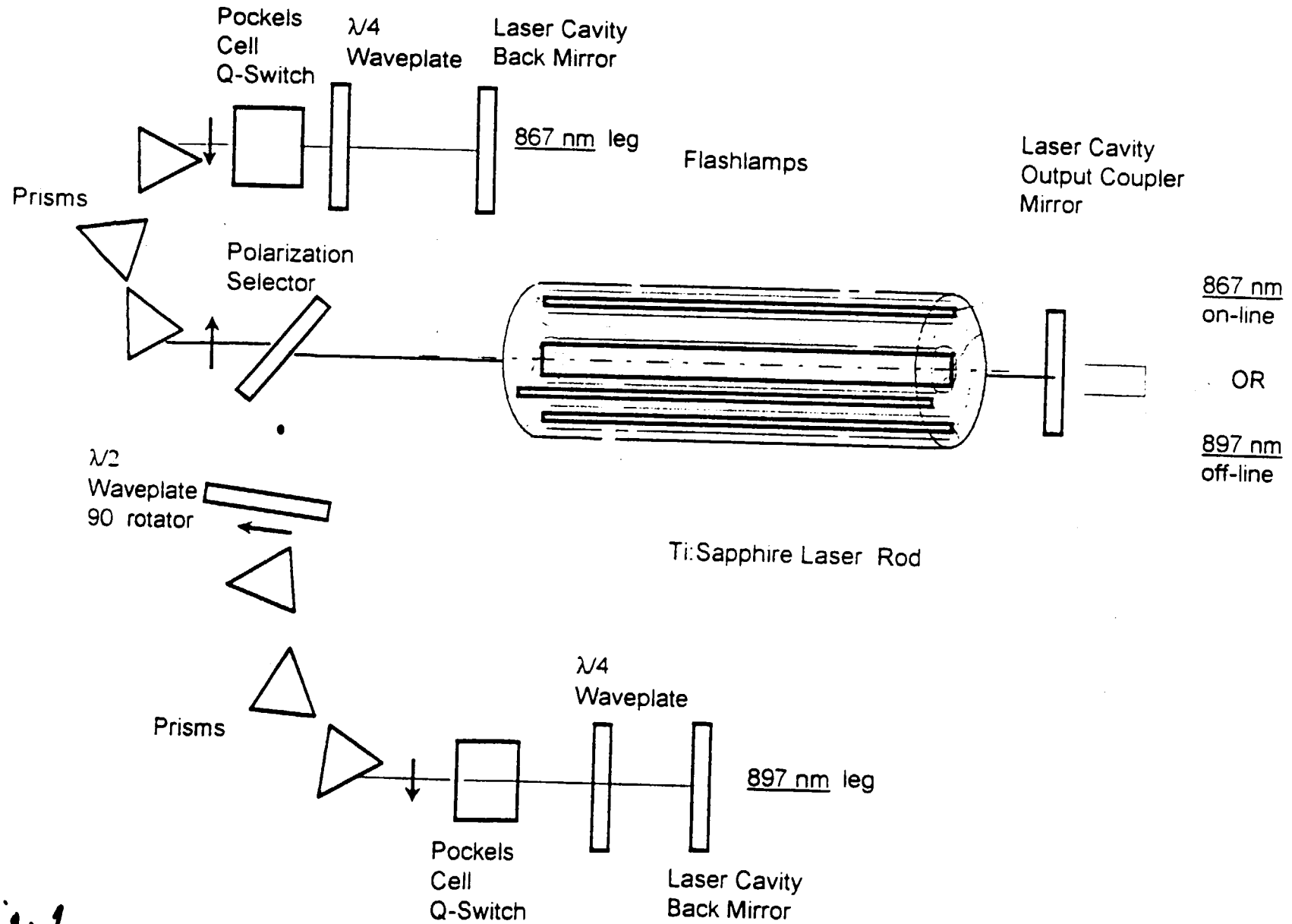
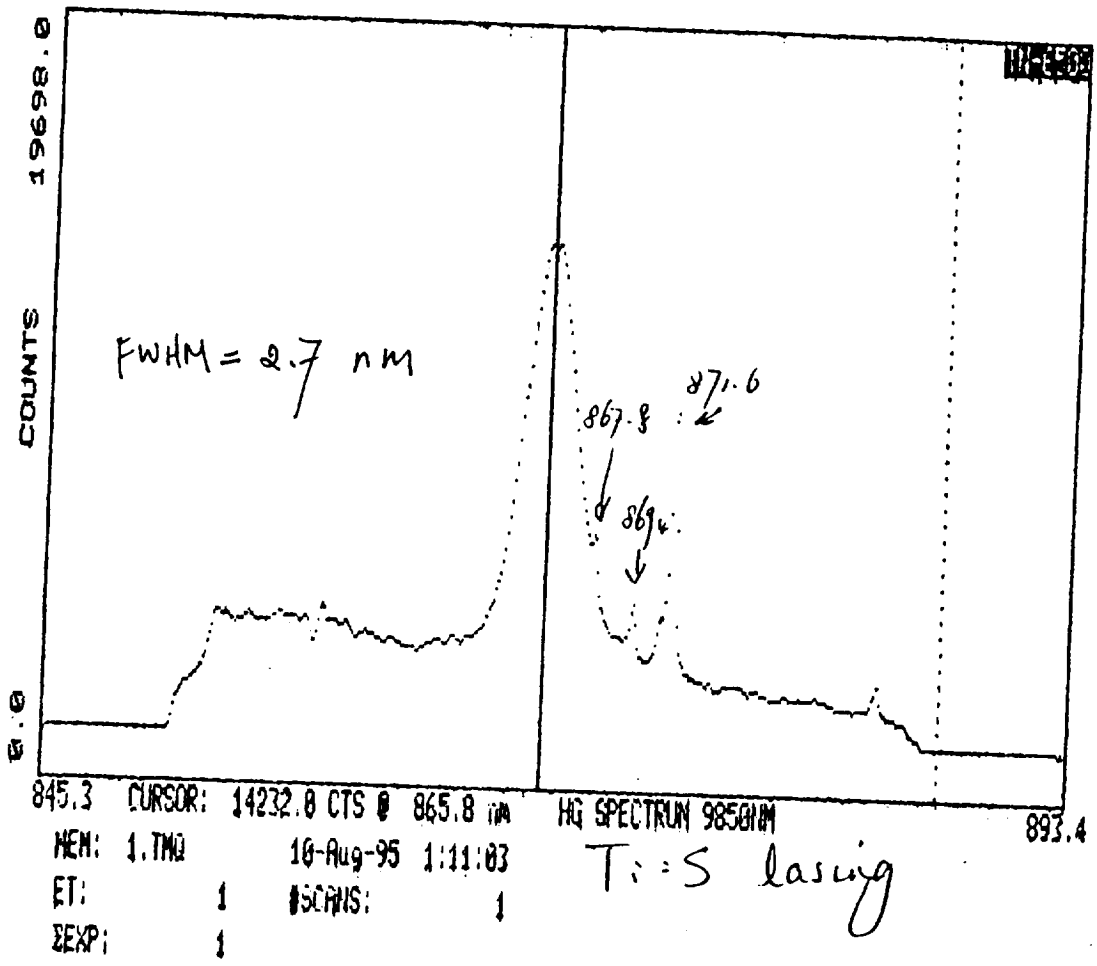


Fig. 1



Ti:S lasing spectrum w/ calibration background of Hg lamp.

Fig. 2